<u>In the Claims:</u>

1. (Currently amended) A dynamically controllable photonic crystal comprising:

a) a structure having a periodic variation in dielectric constant, the structure including a substrate characterized by a substrate refractive index, said structure further including at least one <u>isolated resonant</u> local defect; and

b) means to induce a local change in said substrate refractive index in the vicinity of said at least one local defect, thereby affecting dynamically the propagation of an electromagnetic wave through said structure.

2. (Original) The dynamically controllable photonic crystal of claim 1, wherein said substrate is a semiconductor substrate.

3. (Original) The dynamically controllable photonic crystal of claim 2, wherein said means to induce a local change in said substrate refractive index include means to induce local carrier refraction in the vicinity of said at least one local defect.

4. (Original) The dynamically controllable photonic crystal of claim 3, wherein said means to induce local carrier refraction include means to inject free charge carriers into said semiconductor substrate.

5. (Original) The dynamically controllable photonic crystal of claim 3, wherein said means to induce local carrier refraction include means to deplete charge carriers from said semiconductor substrate.

6. (Currently amended) The dynamically controllable photonic crystal of claim 4, wherein said semiconductor substrate includes a three-layer structure with two

junctions, said three-layer structure further characterized by having a center layer with a **[higher]** lower equilibrium carrier concentration than the concentrations of two external layers, and wherein said means to inject free charge carriers include electrical biases **[applied separately to each said junction for injecting said carriers into said center layer]**.

7. (Currently amended) The dynamically controllable photonic crystal of claim **[4]** 5, wherein said semiconductor substrate includes a three-layer structure with two junctions, said three-layer structure further characterized by having a center layer with a **[lower]** higher equilibrium carrier concentration than the concentrations of two external layers, and wherein said means to deplete free charge carriers include electrical biases **[applied separately to each said junction for depleting carriers from said center layer]**.

8. (Currently amended) The dynamically controllable photonic crystal of claim 6, wherein said three-layer structure with two junctions includes a structure selected from the group consisting of a PIN structure, a PNP structure, a**[n]** NPN structure, a**[n]** N^+NN^+ structure, a P^+PP^+ structure and a MSM structure.

[8] 9. (Original) The dynamically controllable photonic crystal of claim 7, wherein said three-layer structure with two junctions includes a structure selected from the group consisting of a PN^+P structure, a NP^+N structure, a NN^+N structure, and a PP^+P structure.

[9] 10. (Original) The dynamically controllable photonic crystal of claim 2, wherein said semiconductor is silicon.

[10] 11. (Currently amended) A dynamically controllable silicon photonic crystal comprising:

a) a silicon substrate with a periodic array of air rods disposed therewithin, said silicon substrate further including at least one isolated resonant local defect; and

b) means to induce electrically a local carrier refraction change in the vicinity of said at least one isolated resonant local defect, thereby affecting dynamically an electromagnetic wave propagating through the photonic crystal.

[11] 12. (Currently amended) The dynamically controllable silicon photonic crystal of claim **[10]** 11, wherein said air rods are circular, with a diameter larger than that of said at least one local defect.

[12] 13. (Currently amended) The dynamically controllable silicon photonic crystal of claim **[10]** 11, wherein said means to induce electrically a local carrier refraction include means to inject charge carriers locally into said silicon substrate.

[13] 14. (Currently amended) The dynamically controllable silicon photonic crystal of claim **[10]** 11, wherein said means to induce electrically a local carrier refraction change include means to deplete charge carriers locally from said silicon substrate.

[14] 15. (Currently amended) The dynamically controllable silicon photonic crystal of claim **[12]** 13, wherein said silicon substrate includes a three-layer structure with two junctions, said three-layer structure further characterized by having a center layer with a **[higher]** lower equilibrium carrier concentration than the concentrations of two external layers, and wherein said means to inject free charge carriers include electrical biases **[applied separately to each said junction for injecting said carriers into said center layer]**.

[15] 16. (Currently amended) The dynamically controllable silicon photonic crystal of claim **[13]** 14, wherein said silicon substrate includes a three-layer structure with two junctions, said three-layer structure further characterized by having a center layer

with a **[lower]** higher equilibrium carrier concentration than the concentrations of two external layers, and wherein said means to deplete free charge carriers include electrical biases **[applied separately to each said junction for depleting carriers from said center layer]**.

[16] 17. (Currently amended) The dynamically controllable silicon photonic crystal of claim **[14]** 15, wherein said three-layer structure with two junctions includes a structure selected from the group consisting of a PIN structure, a PNP structure, a**[n]** NPN structure, a**[n]** N^+NN^+ structure, a P^+PP^+ structure and a MSM structure.

[17] 18. (Currently amended)) The dynamically controllable silicon photonic crystal of claim **[15]** 16, wherein said three-layer structure with two junctions includes a structure selected from the group consisting of a PN^+P structure, a NP^+N structure, a NN^+N structure, and a PP^+P structure.

[18] 19. (Original) A dynamically controllable photonic bandgap device comprising:

a) a photonic crystal with at least one micro-cavity formed in a substrate, said at least one micro-cavity configured to dynamically manipulate an optical beam; and

b) electrical means to facilitate said manipulation.

[19] 20. (Currently amended) The device of claim **[18]** 19, wherein said substrate is a semiconductor substrate, and wherein said electrical means include means to induce electrically local carrier refraction in the vicinity of said at least one micro-cavity.

[20] 21. (Currently amended) The device of claim **[19]** 20, wherein means to induce said local carrier refraction include means to inject charge carriers locally into said semiconductor substrate in the vicinity of said at least one micro-cavity.

[21] 22. (Currently amended) The device of claim **[19]** 20, wherein means to induce said local carrier refraction include means to deplete charge carriers locally from said semiconductor substrate in the vicinity of said at least one micro-cavity.

[22]23. (Currently amended) The device of claim **[18]**19, wherein said semiconductor substrate is silicon.

[23] 24 (Currently amended) The device of claim **[22]** 20, selected from the group consisting of a tunable optical filter, a tunable optical router, a tunable optical modulator and an optical switch.

[24] 25 (Original) A method for dynamically controlling electromagnetic wave motion through a photonic crystal comprising the steps of:

a) providing a photonic crystal having a substrate characterized by a substrate index of refraction, said photonic crystal further having at least one micro-cavity, the electromagnetic wave motion interacting with said at least one micro-cavity; and

b) electrically affecting a parameter of said at least one micro-cavity, thereby affecting the electromagnetic wave motion through the photonic crystal.

[25] 26. (Currently amended) The method of claim **[24]** 25, wherein said affected parameter is a resonance frequency of said at least one micro-cavity, and wherein said step of electrically affecting said resonance frequency includes electrically inducing a local index change in said substrate index of refraction, in the vicinity of said at least one micro-cavity.

[26] 27. (Currently amended) The method of claim **[25]** 26, wherein said substrate is

silicon, and wherein said substep of electrically inducing a local index change includes locally changing a carrier concentration in said silicon substrate, in the vicinity of said at least one micro-cavity, thereby causing a local carrier refraction effect.

[27] 28. (Currently amended) The method of claim **[26]** 27, wherein said substep of locally changing a carrier concentration includes increasing said carrier concentration by injecting excess carriers.

[28] 29. (Currently amended) The method of claim **[26]** 27, wherein said substep of locally changing a carrier concentration includes decreasing said carrier concentration by extracting carriers selected from the group of excess carriers and equilibrium carriers.

[29] 30. (Currently amended) The method of claim **[26]** 27, wherein said substep of locally changing a carrier concentration is performed using a device selected from the group consisting of two terminal devices and three-terminal devices.

[30] 31. (Currently amended) The method of claim **[29]** 30, wherein said two and three terminal devices include devices selected from the group consisting from unipolar devices, bipolar devices, metal semiconductor devices and metal-oxide-semiconductor devices.

[31] 32. (Original) A method for dynamically controlling a photonic bandgap device built on a substrate, comprising the steps of:

a) forming in said substrate at least one micro-cavity that resonates at a given frequency; and

b) inducing a slight dielectric constant alteration of the substrate in the vicinity of said at least one micro-cavity to obtain a fine resonance tuning of said frequency, thereby obtaining a finely tuned control of an electromagnetic wave propagating in the device.

[32] 33. (Currently amended) The method of claim **[31]** 32, wherein said step of inducing includes inducing said slight dielectric constant alteration of the substrate electrically.

[33] 34. (Currently amended) The method of claim **[32]** 33, wherein the substrate is a semiconductor substrate, and wherein said step of electrically inducing said slight dielectric constant alteration includes electrically inducing carrier refraction.

[34] 35. (Currently amended) The method of claim **[33]** 34, wherein said step of electrically inducing carrier refraction includes an electric field induced action selected from the group consisting of carrier injection and carrier depletion.